UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BERKELEY, CALIFORNIA

CIRCULAR 339
April, 1936

A METHOD OF PREPARING CHURNED CULTURED BUTTERMILK

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THERE IS GREAT VARIATION in the methods used for preparing cultured milk drinks; and, as might be expected, there is also variation in the quality of the buttermilk sold in different cities.

If the quality of buttermilk distributed to the public from day to day, and in different parts of the country, can be made more uniform, consumers will probably use this drink to a greater extent. This circular has been written to promote the preparation of a more uniform product. Churned cultured buttermilk made by the method here described surpasses, in food value and in uniformity, the product made naturally from the churning of cream in buttermaking.

The churning of gathered cream which is separated on farms and sold for buttermaking usually results in a less uniform quality of buttermilk. Such cream usually receives less care on the farm than other milk products; it is delivered to the creameries less frequently and, consequently, fermentations that influence the quality of the buttermilk are more apt to develop in the cream. The buttermilk resulting from the churning of cream is apt also to contain gas-forming and other bacteria which cause a flavor in the cream, and the resulting buttermilk is less pleasing to the consumer.

The churned cultured buttermilk is usually prepared from market milk which is delivered to the dairy plants each day. This better quality of raw material from which the cultured product is made may be expected to produce a more wholesome food than the natural buttermilk prepared in the buttermaking process.

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After several years' study and after discussion of this subject with milk distributors, a product has been developed that has given general satisfaction. It is pleasing in flavor, does not "whey off" readily, contains butter granules and between 1 and 2 per cent of milk fat, which is higher than that of buttermilk resulting from the churning of cream.

MAKING THE STARTER

To make good churned cultured buttermilk, one must use a clean, vigorous starter. The starter is clean whole milk or skim milk inoculated with a pure culture of milk-souring bacteria, which produces a smooth, clean, curdled product.

The culture necessary for propagating the mother starter may be obtained from any reliable dairy laboratory.[3] Both liquid and powder cultures are on the market; either may be used successfully. The liquid culture is designated as lactic ferment culture or butter culture. Printed directions for preparing the mother culture are usually supplied by the laboratory.

PREPARING THE MOTHER CULTURE

The mother culture is prepared by filling two or more sterilized quart milk bottles three-fourths full of clean whole milk or skim milk. A bottle cap is put on, and a double layer of parchment paper is folded over the top of the bottle and held in place with a cord (fig. 1). The milk bottles are then placed in a small galvanized-iron or similar container and surrounded with water to a height greater than the height of the milk. One may keep the level of the water constant by installing an overflow pipe through which the surplus water may escape. Heat may be supplied from a steam pipe installed horizontally in the bottom of the container (fig. 2) or from a gas flame placed underneath. In this way the milk is heated to at least 185° F for one hour in order to destroy most of the bacteria present. A better method, when such equipment is available, is to heat the milk in an autoclave with a steam pressure of 15 pounds for 20 to 30 minutes.

After heating, the milk is cooled as low as possible by running cold water into the hot water surrounding the bottles. The cold water should be added very slowly at first, or the bottles will crack. When heated in an autoclave, the bottles should be allowed to remain exposed to the air at room temperature until they are cool enough to be placed in warm water without breaking. They can then be cooled as described above. The milk should then be cooled further with ice water or in a refrigerator. The usual plant practice is to warm the milk in water to 80° F at the close

[3] A list of dairy laboratories is given at the end of this circular.

of the day and then add the commercial culture or starter. The milk should then be kept as near 80° F as possible during the night until it shows a smooth coagulation the following morning. Some of the liquid cultures available may be started at 72° F. To maintain this temperature

Fig. 1.—Left, bottle of milk for mother culture, sterilized in autoclave at 15 pounds pressure for 20 minutes. The darker color is due to the high temperature of heating, which causes the lactose to become partially caramelized. Right, bottle of milk for mother culture, pasteurized in water bath at 185° F for one hour. The illustration shows method of protecting the pouring lip by covering with parchment tied securely in place.

an electric incubator may be purchased which is equipped with a thermostat that will control the temperature automatically. A homemade apparatus may be substituted which consists of an insulated wooden box, the temperature of which is controlled with water. A quart or more of water at the proper temperature, when placed in the box, will maintain the desired temperatures of the mother culture for many hours. After coagulation these cultures should be cooled by surrounding them with

ice water or by placing them in the refrigerator, unless they are to be used at once.

A bottle of water of the same amount may be placed in the water bath with the milk and this used for the thermometer in taking the temperatures. This procedure will avoid contaminating the milk with the thermometer.

The preparation of the mother culture is continued each day by inoculating two or more bottles of similarly pasteurized and cooled whole milk or skim milk from the mother culture prepared the previous day.

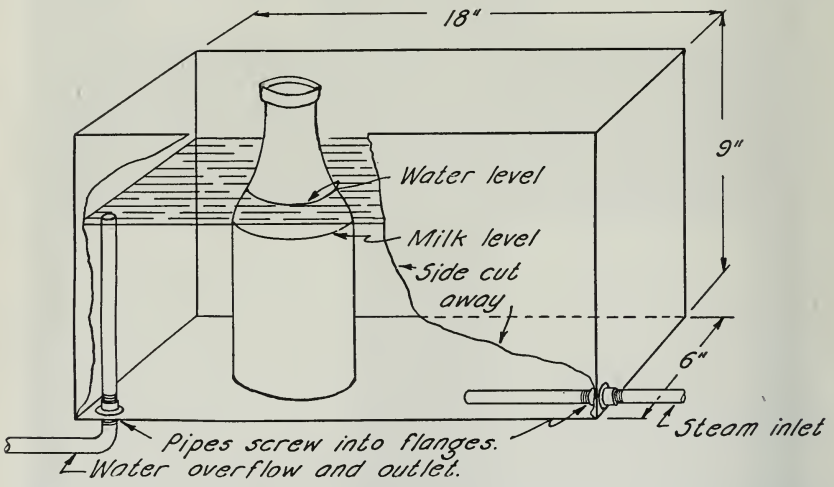

Fig. 2.—Construction of water bath suitable for sterilizing four quart bottles of milk for mother culture. Galvanized iron of 16 gauge is suitable for this purpose. The overflow pipe should be installed in such a manner that it can be readily unscrewed to permit complete drainage when cleaning.

As a precaution, some people prepare two or more lots of starter in order that they may have a better choice in selecting for use a starter with the most desirable flavor, aroma, or other qualities. The amount of culture used should be between 0.5 and 5.0 per cent according to the activity of the culture and the time desired for coagulation. The second day's bottles of milk and those prepared on each succeeding day are incubated at 70° F, as the culture will then have become more active and will develop better at the lower temperature.

PREPARING THE BULK STARTER

The bulk starter is prepared from day to day from the mother culture. The quantity of skim milk needed for the bulk starter is selected and pasteurized in the starter can or in a 10-gallon milk can, according to the equipment available and the quantity of buttermilk to be prepared.

The temperature of pasteurization should remain between 185° and 190° F for one hour. The milk is then cooled to 70° and inoculated with the mother starter. The amount necessary depends upon the activity of the mother starter, the temperature of incubation, and the time desired for the coagulation to be accomplished. When the milk is held at a constant temperature of 70° F, about 1.0 per cent of starter will be required to produce a firm coagulation in 15 hours. Starter should have a clean, acid flavor with an acidity of approximately 0.80 per cent (calculated as lactic acid), be free from gas formation, show no whey separation on top, and be smooth and creamy after thorough agitation. If the starter does not show these characteristics, a new culture should be used.

PASTEURIZING THE SKIM MILK

Skim milk for making churned cultured buttermilk should be selected from the best quality available. This milk must be passed through the separator first, before the bowl has become contaminated from milk of poor quality. This procedure avoids a common source of contamination affecting the quality of the buttermilk. As experiments have shown, the body of cultured milk varies somewhat according to its solids-not-fat content. Skim milk with a lower solids content will coagulate with a thinner body than when the solids content is high. Such milk is preferable to milk of a higher solids content because its greater liquidity makes it more refreshing. The Agricultural Code[4] of California specifies that skim milk shall contain "not less than 8.8 per cent of solids-not-fat." Uniform results from pasteurization can be obtained only by destroying as many bacteria as possible. The fresh skim milk had best be pasteurized as soon as it comes from the separator.

Pasteurization may be accomplished either in a regular pasteurizer or in a starter can, in which the milk should be heated to between 185° and 190° F and held between these temperatures for one hour. It is then cooled as rapidly as possible to the "setting" temperature of approximately 70° F. If pasteurized skim milk is to be transferred to another piece of equipment to be cooled and then held while coagulating, care should be taken to prevent contact with any apparatus that has not been thoroughly cleaned and sterilized.

If skim milk has been pasteurized at 185° to 190° F for one hour and promptly cooled without recontamination, it can then be held several hours, if necessary, until the starter is added, without injury to the product.

[4] The section of the Agricultural Code dealing with preparation, inspection, and sale of dairy products can be obtained in pamphlet form from the California State Department of Agriculture, Sacramento.

For emergency uses reconstituted skim milk may be used instead of fresh skim milk. Skim milk powder used for this purpose should be fresh and of good flavor; otherwise the flavor of the cultured product may be impaired. In California the product must be labeled as being made from reconstituted skim milk. Skim milk powder, if used, should be mixed with water to give a product containing 8.8 per cent solids. In all other respects the processing of reconstituted skim milk is the same as that described for skim milk.

PASTEURIZING THE CREAM

Although the cream may be pasteurized in mixture with the skim milk, experimental results have shown that it is best pasteurized separately at 145° F for 30 minutes. It is then cooled to a low temperature and in the late afternoon is added to the pasteurized skim milk.

The higher temperatures used for pasteurizing the skim milk and the longer holding period would cause some "oiling off" of the cream, as well as churning difficulties, which the lower temperature of pasteurization of cream avoids. If cream and skim milk of good quality are selected and are pasteurized according to the methods described, and if a satisfactory starter is used, uniform results should be secured each day.

ADDING THE CREAM AND STARTER TO THE SKIM MILK

Cream is mixed with the skim milk immediately before or immediately after the starter is added, to provide the milk fat necessary for forming butter granules when it is churned the following morning. The advantage of adding the cream to the skim milk at this time is that it develops more flavor in the finished product, and the exposure of the cream to the acidity aids in forming the butter granules more readily during churning. It also changes the physical condition of the mixture so that foam formation during churning is reduced. This lessens the tendency for the finished product to "whey off" after churning.

A good practice is to add 0.75 per cent fat in the form of cream. This will amount to approximately 4 gallons of 20 per cent cream to 100 gallons of skim milk, or 2 gallons of 40 per cent to 100 gallons. Experiments have shown that the richness of the cream is not important to the quality of the finished product when it is used between 20 per cent and 40 per cent.

Usually the starter and cream are added to the pasteurized skim milk near the close of the day's operation, in order that the starter may act during the night and the product be ready for processing next morning.

When approximately 1.0 per cent of the bulk starter is added to the skim milk in the vat, it will usually be coagulated in 15 hours with an

acidity of approximately 0.80 per cent, provided the temperature of the milk can be held at 70° F during this period. An acidity between 0.70 and 0.80 per cent should be developed before churning. Usually 1 gallon of starter to each 99 gallons of skim milk will give satisfactory results.

Fig. 3.—Left, cultured skim milk containing added cream; when properly churned and cooled before bottling, it did not retain air particles and did not "whey off." Right, cultured skim milk without cream added; when churned and cooled exactly as the sample on the left, it retained air particles and "wheyed off" somewhat, as shown by the band of whey formed near the middle of the bottle.

Immediately after the starter is added, it should be thoroughly stirred to give an even mixture with the milk. If, in cold weather, the skim milk cannot easily be maintained at 70° F, slightly more starter may be required. If the starter is not vigorous, a larger amount may have to be added to complete the coagulation within 15 hours. To assist in maintaining a uniform temperature, a metal or clean cloth cover may be used over the vat. As experiments have shown, the body of cultured milk varies according to the amount of starter used and the length of time

required for coagulation. It is preferable to use a smaller amount of starter and a longer time for coagulation; the result is a thinner body that makes the finished product more refreshing. The firmer coagulation produces a product that leaves an impression of dryness in the mouth and, to the average consumer, is therefore less pleasing.

CHURNING THE CULTURED MILK AND CREAM

When the skim milk and cream mixture has reached an acidity of between 0.70 per cent and 0.80 per cent, it is drawn or poured into the churn, which has previously been properly cleaned, sterilized, and cooled or heated to the proper temperature. During the warm summer months an acidity somewhat lower than 0.80 per cent should be used, for the equipment and air are warmer, and the acidity may increase slightly during the processing.

Likewise, the churning temperature of the product should vary according to the season. As a rule a churning temperature of 68° F during the summer months and 72° F during the winter will be satisfactory. If the temperature is too high, the butter granules formed during churning will mat together and prevent an even distribution of small granules throughout the finished product.

Salt, added to the cultured skim milk before churning, improves its palatability for most consumers. The amount of salt to use depends on the demands of the consumer. Usually ½ ounce of salt to each 10 gallons of milk will be satisfactory.

Butter color may also be added to give the butter granules a higher color. The amount used may also, as in buttermaking, vary with the season, the object being to maintain a uniform color throughout the year. During the winter months as much as 2½ cubic centimeters of butter color for each 10 gallons of milk may be required.

The churn is operated at high speed until small butter granules about the size of a pinhead are formed. With the temperatures recommended and with the churn approximately half full, the churning time will be 6 to 10 minutes. Prolonged churning increases the size of the butter granules and may be detrimental to the flavor and body. Any treatment that incorporates air in the product after acidity has developed will encourage "wheying off" (fig. 3).

The small granules are usually preferred because they are less noticeable when the product is consumed and because, having less buoyancy, they are more evenly distributed throughout the bottled buttermilk.

ADDING CREAM AND COOLING THE CHURNED BUTTERMILK

The churned cultured buttermilk should be drawn from the churn immediately into a coil vat or other apparatus. It should not be bottled until the air that may have become incorporated during churning has come to the surface.

Fig. 4.—Left, the cultured milk was churned, cooled immediately, and stored in bulk for two hours before it was bottled; no "wheying off" occurred. Right, the cultured milk from the same churning was bottled before cooling. The air particles retained in the milk at the time of bottling caused a separation of the curd and the formation of "free" whey near the middle of the bottle.

The same amount of sweet cream as was used before churning is added, and the mixture is cooled immediately to 40° F or below. This gives the finished product a fat content of approximately 1½ per cent. The addition of cream after churning gives a smoother body and a milder and more pleasant flavor.

Slight modifications of this process may be made, such as varying the

amounts of cream used or eliminating the addition of cream after churning; but such changes will modify the quality and will be less satisfactory if a high-quality product is desired.

When churned cultured buttermilk has a high viscosity, the body is thicker and the product less refreshing. The viscosity, after churning, may be reduced by adding 5 per cent of pasteurized milk or pasteurized skim milk without causing any noticeable change in the appearance. If as much as 10 per cent of milk or skim milk is added, it may accumulate as a noticeable layer at the bottom of the bottle or cause "wheying off."

BOTTLING AND STORAGE

After the buttermilk has been cooled to 40° F it is held in bulk at this temperature in the vat in which it was cooled or in the storage room for several hours, until the body has thickened sufficiently to prevent the butter granules from rising to the surface.

It is then agitated to distribute the butter granules before bottling. If sold in bulk it may then be drawn into cans for distribution.

Churned cultured buttermilk is bottled in the same way as fresh milk, with the regular milk-bottling equipment. After bottling, the milk should be placed immediately into the cold-storage room until the time of delivery.

DELIVERY

The distributor of churned cultured buttermilk should realize that the product contains a large number of milk-souring bacteria. While the milk is maintained at 40° F they do not increase appreciably in number and the acidity remains constant. If the temperature rises above 50°, the organisms increase in number slightly; and at higher temperatures they reproduce rapidly, causing increased acidity and finally a change in the milk which may cause an earlier "wheying off." The increase in acidity also changes the flavor, which may finally become sharp and less pleasing to the consumer.

In order to retain the original flavor of churned cultured buttermilk the bottles should be surrounded with ice during delivery, and consumers should be advised to keep it cold.

CLEANING, STERILIZING, AND CARE OF EQUIPMENT

The quality of churned cultured buttermilk depends upon the ability of the dairy plant operator to control the growth of bacteria. This statement applies from the beginning of the manufacturing process to the final delivery to the consumer. For best results, the original milk used must be as free as possible from undesirable bacteria, some of which are

not destroyed by pasteurization; all the equipment and apparatus with which the milk comes in contact must be as free as possible from contamination; and all temperatures must be controlled accurately.

The importance of properly sterilizing all equipment cannot be overemphasized. A detailed description of sterilization is not attempted in this publication; but the operator must heat all equipment to a temperature near the boiling point in order to destroy the bacteria on the surface and, after such heating, must leave the equipment open for a brief period to permit the moisture to escape and to let the surface of the equipment dry. The spores of some bacteria are resistant to the boiling temperature, but if the equipment is left dry, bacteria will not reproduce from the spores and contaminate the apparatus before it is used the following day.

PREPARATION OF THE CHURN

The churn may be one of the most serious sources of contamination because of its wood construction, which cannot be easily sterilized. When buttermilk is prepared each day, the churn should be rinsed free of milk and butter particles as soon as the buttermilk is removed. This can best be done with a small stream of cold water from a hose, while the drain gate is left open. Finally, the drain gate should be closed and the churn revolved while one-fourth full of cold water and again drained. The churn should then be filled one-third full of hot water of a temperature of 185° F or above and revolved in low gear for 10 or 15 minutes. The door should then be removed from the churn, and the opening turned to the floor to permit the water to flow out at once. After draining, the churn, while still warm, should be turned with the door-opening upward to permit drying. Later the cover may be replaced and left ajar to permit moisture to escape and to protect the churn from dust.

If the churn becomes sour or if mold develops on the inner surface from lack of regular use, it may be treated with lime, as is customary in buttermaking, and then brushed thoroughly with washing solution, sterilized, and dried.

FOOD CONSTITUENTS OF BUTTERMILK

For centuries, milk has been recognized as an almost indispensable food for mankind and as a supplementary feed for animals. Churned cultured buttermilk, when made as described in this circular, contains all of the constituents of whole milk. The principal differences in the composition of whole milk and churned cultured buttermilk are that the fat percentage of the latter is about one-third that of whole milk, and the

milk sugar is reduced about one-third as a result of the change of a portion of the milk sugar into lactic acid.

Chemical analysis of samples of churned cultured buttermilk manufactured according to these directions shows an average composition of 1.5 per cent milk fat, 2.85 per cent protein, 3.80 per cent milk sugar (lactose), and 0.82 per cent minerals. From the standpoint of food value, the milk fat is a very important constituent of buttermilk as it supplies heat, energy, and vitamins necessary to the human body. Since a portion of the fat is churned and a portion unchurned, the result is an attractive appearance as well as a rich, mild, pleasing flavor. Some consumers who are interested in keeping the fat content of their diet to a minimum prefer to use this product instead of whole milk. Proteins are essential in the diet for building new or replacing wornout tissues in the body.

ACKNOWLEDGMENTS

Acknowledgment is made of the assistance given by Mr. J. L. Henderson of the Dairy Industry Division, who helped score the experimental samples of churned cultured buttermilk, and of the helpful suggestions made by Mr. Fred Kopp. Appreciation is also expressed for the assistance of Mr. S. F. Aichholz, Mr. M. J. Fechter, and Mr. I. D. Boone in carrying out the details of some of the early experiments.

PARTIAL LIST OF LABORATORIES FROM WHICH CULTURES MAY BE PURCHASED

Dairy Products Laboratory, 3870 17th Street, San Francisco, California.
Griffin Hassen Laboratories, 648 East 21st Street, Los Angeles, California.
Knudsen Laboratories, 1957 Santee Street, Los Angeles, California.
Hansen Laboratories, 9015 W. Maple Street, Milwaukee, Wisconsin.
Elov Ericsson Company, 1098 Livingston Avenue, St. Paul, Minnesota.
The Dairy Laboratories, Third and Locust Streets, Philadelphia, Pennsylvania.

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